R E M A R K S

Claims 9, 12, 16, and 18 were rejected under 35 USC 103 as being obvious in view of the combination of US 2001/0036221 ("Sato") and USP 7,257,148 ("Suzuki '148"); claims 15 and 17 were rejected under 35 USC 103 as being obvious in view of the combination of Sato, Suzuki '148, and US 2002/0167991 ("Suzuki '991"); and claims 10, 11, 13 and 14 were rejected under 35 USC 103 as being obvious in view of the combination of Sato, Suzuki '148, and JP 6-90222 ("JP '222").

These rejections, however, are respectfully traversed because: 1) the cited prior art does not disclose all of the features of the claimed present invention; and 2) it would not have been obvious to modify the cited prior art to achieve the claimed present invention.

Summary of the Present Invention

The claimed present invention is directed to a device for spread spectrum communication which can establish high-speed synchronization of spread codes, and a spread spectrum communication method which enables high-speed synchronization of spread codes.

According to the claimed present invention, synchronization of spread codes is carried out primarily in three steps as follows.

(1) First, in a toggle detecting unit, correlation between a received signal and an expected signal is calculated (the expected signal having a length corresponding to or shorter than 2 chip-times of a spread code), and candidates of toggle points which are expected to be in the received signal are detected. The toggle points detecting process is neither synchronization of spread codes nor demodulation of a received signal, but rather, it is an analysis necessary to carry out synchronization and demodulation. In other words, the toggle points detecting process is a primary analysis performed before carrying out synchronization and demodulation.

(2) Next, correlation between two signals is calculated. The two signals are: a) a result of the primary analysis obtained by the foregoing procedure (the result of which is a signal comprised of a sequence of toggle point candidates detected by the toggle detecting unit); and b) a signal comprised of a sequence of other toggle point candidates generated from a pre-held spread code (the spread code is expected to be in the received signal). Then, using the correlation, shift amount of a spread code expected to be in the received signal is calculated.

(3) Finally, in a demodulating unit, according to the shift amount calculated in the second step, the pre-held spread code is shifted by the shift amount, and the shifted spread code is multiplied by the received signal. As a result of the

multiplication, the received signal is demodulated and effectiveness of a carrier spectrum of the received signal is inspected.

An important aspect of the claimed present invention is that the pre-held expected signal used in the toggle detecting unit is <u>not</u> a signal having a length equal to a whole length of a spread code, but rather, it is a signal having a length no more than 2 chip-times of a toggle point expected to be in a spread code (i.e., 1 chip-time before a toggle point and 1 chip-time after a toggle point).

Indeed, the pre-held expected signal used in the claimed present invention is not a N chip-length signal (N>=2) comprised of plural (more than one) 2 chip-length signals. Rather, it has a length no more than 2 chip-times of the spread code. Thus, the expected signal used in the demodulation unit is a set of candidates of toggle signals aligned in a length corresponds to one cycle of a spread code (i.e., an entire length of a spread code).

The claimed present invention therefore carries out synchronization of spread codes directly using a modulated waveform of a carrier wave (i.e., a waveform prior to demodulation to a baseband signal), and thus differs from conventional methods which demodulate a received signal to a

baseband signal before carrying out synchronization of spread codes.

This change in the order of synchronization and demodulation is an important distinction of the claimed present invention and is not an obvious modification of the cited prior art, as explained more fully below.

Another important aspect of the claimed present invention is that it does not apply a sliding operation on a pre-held expected signal, when calculating correlation between a received signal and the pre-held expected signal, so that synchronization of spread codes is established much faster than conventional methods in which synchronization is realized by calculating the correlation between a received signal and a pre-held expected signal, while repeatedly varying the pre-held expected signal, or sliding the pre-held expected signal.

Lack of Claimed Features in the Cited Prior Art

It is respectfully submitted that the cited prior art references do not disclose, teach or suggest a toggle detecting unit as set forth in independent claim 9 or the functions performed thereby as set forth in independent claim 12.

With respect to the spread spectrum communication device as according to claim 9, the spread spectrum communication device includes a toggle detecting unit and a demodulating unit (and

claim 12 recites similar functions of these units using method terminology). A toggle detecting unit is not disclosed in the cited prior art references, and the demodulating unit of the claimed present invention functions differently than demodulating units in prior art devices.

The toggle detecting unit calculates correlation between a received signal (shown in Fig. 5(a)) and an expected signal having a length equal to or shorter than 2 chip-times (shown in Fig. 2), and then, according to the result, it searches the positions of phase changing points expected to be in the received signal shown in Fig. 5(a). The set of phase changing points obtained by the above procedure is the toggle signal shown in Fig. 5(b).

The received signal provided to the toggle detecting unit is not a signal which has been demodulated to a baseband signal, but rather is a modulated waveform of carrier wave itself. The toggle detecting unit detects phase changing points expected to be in a received signal but whose positions are unknown, i.e., unknown as to what value of spread code is in the received signal, not just unknown as to the shift amount of a pre-held, pre-determined spread code.

The toggle detecting unit tries to find phase changing points whose positions are unknown. As a result, in the toggle detecting unit, it is impossible to use one whole cycle of a

pre-determined spread code as an expected signal. So, the toggle detecting unit uses a signal which indicates the waveform of 2 chip-times of a phase changing point (shown in Fig. 2) as a pre-held expected signal.

Neither Sato nor Suzuki '148 (cited in the rejection of claims 9 and 12) disclose structure which performs the same functions as the toggle detecting unit described above.

Sato describes a shift-amount calculation method which calculates the shift amount of a spread code in a demodulated signal (i.e., a baseband signal demodulated from a received signal). Sato, however, does not disclose finding phase changing points whose positions are unknown and thus, Sato cannot disclose the fundamental function of the toggle detecting unit as according to the claimed present invention.

Suzuki '148 provides an expected signal shown as SG505 in Fig. 6E which has a length equal to or shorter than 2 chip-times. However, Suzuki '148 also employs a signal which has a length corresponding to one whole cycle of a spread code (i.e., the entire part of SG505 in Fig. 6E) as an expected signal. And Suzuki '148 does not use only one of the impulse signals as an expected signal.

In view of the foregoing, it is respectfully submitted that Sato and Suzuki '148 do not disclose a toggle detecting unit or the functions performed thereby.

The cited prior art references also do not disclose, teach or suggest a demodulating unit as set forth in claim 9 or the functions performed thereby as set forth in claim 12.

First, it is respectfully pointed out that there is a significant difference in the overall structure of the spread spectrum communication technique of Sato and that of the claimed present invention so that the demodulating unit of Sato is not comparable to the demodulating unit of the claimed present invention.

Sato utilizes a technique which provides a path search circuit for a receiver which uses a DS-CDMA communication method (see paragraphs 0066-0067). In spread spectrum communication, the synchronization process is classified in two stages: 1) initial synchronization acquisition (or synchronization establishment) and 2) synchronization tracking. Sato relates to a method for synchronization tracking, which is a process which is carried out after an initial synchronization acquisition has been achieved. Thus, the demodulating unit of Sato is applicable only when performing synchronization tracking.

By contrast, the claimed present invention relates to a method for initial synchronization acquisition or synchronization establishment (see, for example, the preamble of claim 12). And since the present application and Sato are different in their domain of applicability of spectrum communication, the

demodulating unit of Sato does not function in the same manner as that of the invention, i.e., as used for synchronization establishment.

In view of the foregoing, it is respectfully submitted that the cited prior art references, and in particular Sato, do not disclose a demodulating unit in a synchronization establishing method or device which performs such as method, as according to the claimed present invention.

Lack of Obviousness in Combining Prior Art

It is also respectfully submitted that it would not have been obvious to modify Sato in view of Suzuki '148 to achieve the claimed present invention.

In the Final Office Action, the Examiner asserts that it would have been obvious to modify Sato "to create an improved system with increases tolerance to interference and improved synchronization timing for high speed signals."

It is respectfully submitted the proposed reasons for modifying Sato are unjustified and unrelated to advantages that could be provided by the modified structure and method of Sato.

The claimed present invention provides for initial synchronization for spread spectrum communication (i.e., establishing such communication) faster than conventional methods. Thus, there is a speed element whereby the claimed

present invention avoids the relatively time-consuming step of varying or sliding a pre-held expected signal while correlating between this pre-held expected signal and a received signal as in conventional methods.

The construction of a spread spectrum communication device and method to achieve this purpose does not have any discernible effect on "tolerance to interference" or "synchronization timing", the reasons provided by the Examiner to justify the obviousness of combining Suzuki '148 with Sato.

Therefore, it is respectfully submitted that there is no justifiable reason why one of ordinary skill in the art would combine teachings of Suzuki '148 with Sato.

In view of the foregoing, it is respectfully submitted that the present invention as recited in independent claims 9 and 12 and dependent claims 10, 11 and 13-18 clearly patentably distinguish over Sato, Suzuki '148, Suzuki '991 and JP '222 under 35 USC 103.

Dependent claims

Still further, it is respectfully submitted that the cited prior art references do not disclose various features of the dependent claims. In particular, it is respectfully submitted that the cited prior art references do not disclose the features of claims 10, 11, 13 and 14, and that it would not have been

obvious to modify and combine Sato, Suzuki '148 and JP '222 to achieve the features recited in these claims.

JP '222 was applied to disclose features of claims 10, 11, 13 and 14. However, JP '222 does not disclose, teach or suggest a toggle detecting unit which outputs a toggle signal as a result of detecting the candidate of the toggle point or a candidate of the shift amount being calculated based on cross-correlation of the toggle signal and an absolute value of a differentiated value of the spread code, as set forth in claims 10 and 13, and the candidate shift amount calculation as set forth in claims 11 and 14.

With respect to the toggle detecting unit, the toggle signal of the present invention is a sequence of candidates of toggle points, which is obtained by calculating the correlation between an expected signal and a received signal, while assuming a signal which shows a waveform of 2 chip-times of a phase changing point as a pre-held expected signal.

In JP '222, the signal which the Examiner appears to consider to correspond to the claimed toggle signal is obtained by performing differential detection, and not as a result of detecting the candidate of the toggle point as in the claimed present invention. Specifically, in JP '222, the input to element 104 is a signal converted to a baseband signal from a

received signal and thus is fundamentally different than the toggle signal of the present invention.

With respect to the calculation of the candidate of the shift amount, in the claimed present invention, the absolute value of a differentiated value of the spread code in the present invention is prepared for calculating the correlation between a toggle signal and a received signal. A singular calculation of the candidate of the shift amount is performed.

In JP '222, a pre-held spread code is shifted according to the data-timing signal emitted from element 104 shown in Fig. 1 thereof. The shift operation is a fine adjustment of the shift amount of a pre-held spread code, and it is not a singular calculation but requires repeat calculations of the correlation between a received signal and the pre-held spread code shifted in the same manner. Moreover, the squaring operation which is carried out by element 108 squares the result of multiplication between the pre-held expected signal (PN code) and a received SS signal and thus does not constitute an absolute value of a differentiated value of the spread code.

With respect to the function of the demodulating unit to demodulate the received signal by shifting the spread code with respect to each candidate of the shift amount, the present invention does not use a sliding correlator while JP '222 uses a sliding correlator. As such, the demodulating unit of JP '222

does not function in the same manner as the demodulating unit in the claimed present invention.

With respect to inspecting of the effectiveness of a carrier spectrum of the demodulated received signal, in the claimed present invention, the carrier frequency is demodulated and detected <u>after</u> the synchronization is established and thus is different from that in JP '222 wherein frequency synchronization is first gradually established by adjusting the frequency of the VCO 100.

With respect to claims 11 and 14, moreover, in the claimed present invention, the shift amount of a spread code is obtained by calculating the correlation between a Fourier transformed value of a toggle signal and a Fourier transformed value of an absolute value of a differentiated value of a spread code. This calculation is a singular calculation and utilizes a relationship between power spectrum and cross correlation, known as "Wiener-Khintchine theorem". More specifically, a Fourier transform is performed on a toggle signal which is a sequence of candidates of toggle points obtained by calculating the correlation between a pre-held expected signal and a received signal, while assuming a signal which shows a waveform of 2 chip-times of a phase changing point as the pre-held expected signal. The toggle signals thus have only a phase changing status.

In Sato, an even number signal and odd number signal (rxd1, rxd2 in Fig. 3) are prepared by interleaving a baseband signal which is converted from a received signal, then rxd1 (or rxd2) is divided into two halves as shown in Fig. 5, and finally a Fourier transform is carried out on each half generated from rxd1 (or rxd2). The signals rxd1 and rxd2 convey more information than a phase changing status, which would be in a received signal. Since the signals on which a Fourier transform is performed in the claimed present invention only have a phase changing status, the target signals on which a Fourier transform is carried out in Sato are significantly different.

Moreover, the Fourier transformation of absolute value of the differentiated value of the spread code is a spread code which is previously held in a receiver as an expected signal, and it is not a received signal (nor a signal generated from a received signal). By contrast, the operation carried out in Sato, by element 202 as noted in the rejection, is a Fourier transform on a baseband signal which is converted from a received signal. Element 202 does not form or operate on a Fourier transformation of the absolute value of the differentiated value of the spread code as in the claimed present invention.

Accordingly, it is respectfully submitted that the cited prior art references do not disclose the features of claims 10, 11, 13 and 14, and that it would not have been obvious to modify

and combine Sato, Suzuki '148 and JP '222 to achieve the features recited in these claims.

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In view of the foregoing, it is respectfully submitted that the present invention as recited in independent claims 9 and 12, and claims 10, 11, 13, 14 and 15-18 respectively depending therefrom, clearly patentably distinguishes over Sato, Suzuki '148, Suzuki '991 and JP '222, taken in any combination consistent with the respective fair teachings thereof, under 35 USC 103.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned for prompt action.

Respectfully submitted,

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